

Preoperative measurement of haemoglobin concentration

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SUMMARY

Haemoglobin concentrations were estimated in 1158 patients admitted to hospital for elective surgical procedures. Haemoglobin concentration below 10 g/dl was not seen in male patients who were fit and healthy, or had mild or severe non life threatening systemic diseases. In female patients haemoglobin concentration below 10 g/dl was seen in 0.3% of normal fit healthy patients, 2% of patients with mild systemic diseases, 6.4% of patients with severe, non life threatening diseases, and 18.7% of those with severe incapacitating diseases. Routine haemoglobin measurement is unnecessary in fit healthy patients, or in those with mild systemic disease (American Society of Anesthesiologists grades 1 or 2), but should be done in those with more severe systemic diseases (American Society of Anesthesiologists grades 3, 4 or 5).

INTRODUCTION

Measurement of the haemoglobin concentration in blood remains one of the most frequently performed preoperative investigations. It is of value for many reasons: it may aid diagnosis, especially when accompanied by an indication of red cell morphology; it may give an indication that intra or postoperative blood transfusion will be needed; it may screen for unexpected anaemia; and lastly, it may influence the anaesthetic technique.

In the anaemic patient, cellular oxygen demands may only be satisfied if cardiac output is increased (with an increase in stroke volume),¹ and hypoxaemia may accompany the fall in cardiac output associated with the induction of anaesthesia.² A fall in haemoglobin concentration is associated with an increase in cardiac output and conversely, any increase in haemoglobin concentration is associated with an increase in viscosity and a fall in tissue perfusion. A packed cell volume of 0.30, or a haemoglobin concentration of 10.0 g/dl probably gives optimal tissue perfusion and oxygen carriage. The majority of anaesthetists would consider a haemoglobin concentration of 10.0 g/dl as the lower acceptable limit prior to elective surgery, unless compensation has occurred as in the case of chronic renal failure. Some would accept values as low as 9.0 g/dl.³ Carson and colleagues⁴ demonstrated that in patients who declined transfusion, the operative mortality was 7% when preoperative haemoglobin concentration was above 10 g/dl, but 61% if the concentration was below 6 g/dl.

Dundee⁵ has shown that the induction dose of sodium thiopentone is related to the preoperative haemoglobin concentration by the formula: Log dose of thiopentone = $0.995 + 0.019 \times \text{Hb}$. The patient with a low haemoglobin

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concentration is therefore at increased risk from anaesthesia. Routine measurement means testing many healthy patients unnecessarily, and has been suggested that age may be a useful criterion for requesting this investigation. The aim of this study was to evaluate the American Society of Anesthesiologists (ASA) grading system as a criterion for haemoglobin measurement prior to anaesthesia and surgery.

METHODS

1158 (704 female, 454 male) patients admitted for elective surgical procedures at this hospital over a 9 month period were studied. Those with known active bleeding were excluded. Each patient was allocated an ASA grade depending on the preoperative history and examination (Table I). A routine 2.5 ml sample of venous whole blood was obtained for laboratory haemoglobin measurement using an automated Coulter counter.

TABLE I
American Society of Anesthesiologists grading system (ASA)⁹

1. Normal, fit healthy patient.
2. Mild systemic disease.
3. Severe systemic disease, not a constant threat to life.
4. Severe, incapacitating systemic disease which constitutes a constant threat to life.
5. Moribund, not expected to live for 24 hours with or without surgery.

RESULTS

The number and mean age of patients allocated to each group are shown in Table II. No patients in grade 5 were seen as the surgery was elective in nature. Ages ranged from 6 months to 98 years. No male patient in ASA grade 1 to 3 had a haemoglobin concentration below 10 g/dl. In the female patients, many of whom were of reproductive age, haemoglobin concentrations of less than 10 g/dl were seen in 0.3% of those of ASA grade 1, 2% of grade 2, 6.4% of grade 3 and 18.7% of grade 4. The mean haemoglobin concentration in the 454 males was 14.2 (+/- 0.14) g/dl, and in the 704 females 13.0 (+/- 0.09) g/dl.

TABLE II
Mean age and haemoglobin concentration in 1158 patients admitted for elective surgery, classified by ASA grades of preoperative fitness. The percentage of patients with haemoglobin concentrations below 10 g/dl and above 17 g/dl is shown

ASA grade	n	Age	Hb g/dl (SEM)	Range	< 10 g/dl	> 17 g/dl
1 Male	174	35	14.6 (0.1)	11.1 - 17.9	0%	2.3%
1 Female	366	33	13.1 (0.1)	9.9 - 17.5	0.3%	0.3%
2 Male	118	55	14.3 (0.1)	10.4 - 17.4	0%	2.5%
2 Female	197	47	13.0 (0.1)	9.4 - 16.7	2.0%	0%
3 Male	133	59	13.8 (0.2)	10.3 - 18.2	0%	2.2%
3 Female	125	61	12.7 (1.7)	8.7 - 17.9	6.4%	1.6%
4 Male	29	69	13.4 (0.4)	8.9 - 17.9	3.5%	3.4%
4 Female	16	77	12.2 (0.6)	8.2 - 16.7	18.7%	0%

DISCUSSION

Less than 1 % of patients in this study had haemoglobin concentrations below 10 g/dl, in agreement with the results of Walton⁶ and of Gold and Wolfersberger.⁷ The low incidence of anaemia implies that this investigation is performed unnecessarily in many preoperative patients. In the absence of bleeding, and prior to procedures in which blood loss is expected to be low, this test is unlikely to be of value in the fit and healthy (ASA grade 1) patient. Apparently healthy patients sometimes present for surgery and are found to be anaemic, but a careful history and examination will usually show symptoms such as lethargy or breathlessness, and signs of a hyperdynamic circulation such as tachycardia and bounding pulse at rest, which exclude them from ASA grade 1. In the absence of these signs, circulatory compensation for chronic anaemia (as in chronic renal failure) with increase in plasma volume and rightward shift of the oxygen haemoglobin dissociation curve means that anaesthesia is likely to be relatively well tolerated.

The higher incidence of low haemoglobin concentration in ASA grades 3 and 4 indicates that this investigation should be performed in all preoperative patients in these groups. In other words, all those with signs and symptoms of systemic disease. A raised haemoglobin concentration also leads to increase in perioperative risk from thromboembolism, and may be due to polycythaemia or to dehydration. A haemoglobin concentration above 17 g/dl may indicate the need for preoperative venesection or fluid replacement depending on the aetiological cause. This occurred in only two of 704 female patients in this study, but in from two to four percent of male patients regardless of ASA grade.

It is presently recommended that haemoglobin concentration should be measured preoperatively in those over 40 years,⁸ or in the presence of cardiovascular or respiratory disease. Chronological age, however, gives no indication of physical health, and some young patients have severe systemic disease. The ASA guide is a logical, easily learnt patient classification system, and gives an accurate indication as to when measurement of haemoglobin concentration is likely to give results which will affect clinical practice. This classification is commonly performed by the anaesthetist, but could easily be performed as well by the house surgeon. It may still be necessary to measure the haemoglobin concentration for diagnosis or assessment of treatment, but the vast number of tests routinely requested as a preoperative check can safely be reduced.

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